been applied to cancer in general. The distribution of these lachrymal glands correspond quite closely to the distribution of rodent ulcer on the face.

My theory is that those regions are most subject to rodent ulcer that are least mobile, and consequently least vitally nourished. The growth of the beard or the use of the razor stimulates the functional activity of these parts. The cheeks are active in mastication; the upper lid does practically all the dusting of the eyeball. The cutaneous structures at the corner of the eye, the nose itself, the ears and malar prominences have no underlying muscles, no mobility, no stimulation to activity. If the abortive gland theory were correct both sexes ought to be equally affected, but according to my figures only 12% were found in women. This disparity between the sexes is to be accounted for in part by the greater care expended on the face by women. The copious use of facial creams, frequent massage, etc., maintain a greater vitality in the skin. Then, too, women are endowed with an extra layer of adipose that still further maintains the tonicity of the skin.

The more degenerate, or the less vital the structure, the more the liability to cancer. In the general atrophy of the skin incidental to old age, those places devoid of all subcutaneous mobility are most liable to rodent ulcer. That seems to me the most plausible explanation of the peculiar distribution of facial cancer.

EVOLUTION IN THE STUDY OF THE HEART: A SURVEY.*

By HARRY I. WIEL, M. D., San Francisco.

Privilege indeed it is to live in a renaissance period. When we stop to consider how for centuries medicine has stood ineffectual in the face of the morbid heart, groping here and there for light in the midst of darkest ignorance and unable to attain any efficiency in this field, it is a great satisfaction to know that our own times have finally opened up new paths to knowledge and treatment of chronic heart disease. Dealing with the history and evolution of this matter, tracing the various steps by which this decidedly advanced and new knowledge has been attained, has proved a study of great fascination to the writer and it may be that the readers of this sketch will experience like enthusiasm in following this evolution with him, from ancient days to now.

Concerning the earliest years there is little to note in the way of progress. The views of Hippocrates, Aristotle and Galen held sway for centuries. These recognized the heart, arteries and veins and included in the system we now know as circulatory, the liver. There were supposedly two bloods, the natural and vital, in two closed systems, the veins and arteries. The liver was regarded as the central organ of the venous system, in which chyle was converted into blood, and from which it was distributed by the veins to the various parts of the body for nourishment. The structure of the heart and the direction in which the blood passed was known, but the chief function of the organ resided in the left ventricle where the "vital spirit" was created, a mixture of inspired air and blood. By alternate dilatation and collapse of the arteries, this mixture was kept in constant motion. Allowance was made in this scheme for a small amount of blood going from the right side of the heart to the lungs for their sustenance, and thence back to the left side of the heart. There was, however, no conception at all definite of the pulmonary circulation as such; in fact the main communication between the two sides of the heart was supposed to be by means of pores between the meshes of the interventricular septum.

Such in outline was the accepted idea of the cardio-vascular system which prevailed for centuries. It remained for that extremely fascinating character in the history of medicine, Michael Servetus of Villanova, Spanish born, theologian and scientist of continental Europe, the valiant and splendid heretic, contemporary of Vesalius, to make the first enlightened contribution. Sir William Osler, in a masterly biographical sketch of the man, has brought together with inimitable excellence, our knowledge of Servetus, and this society is indebted to the Regius Professor of Medicine in Oxford, for a reprint of that portion of the fifth book of "Christianissimi Restitutio" which contains the important scientific work of Servetus.

In this theological work, Servetus, in a few paragraphs, gives the now noted description of the lesser circulation. These facts he most probably discovered from dissection in the anatomical laboratory, for there is no record of any such thing in this affair as observation from the living organism. To Servetus himself, and to his contemporaries, the matter seemed of little import, and as far as clearing our ignorance in the problem of the circulation, it surely was of little significance. Literature does not remark much stir in scientific circles following this discovery. A certain Colombo a few years later announced the same observations with the addition of noting that the blood became mixed with the inspired air in the lungs and not in the heart, but all these things caused no more commotion than the contribution of Servetus himself. The influence of Galenical teachings was still rampant, and Servetus's work was allowed to remain hidden until after the publication of the greater work of William Harvey, nearly 100 years later. Charles Bernard, a surgeon of St. Bartholomew's Hospital in London, called the attention of William Wotton in 1697 to the important work of Servetus which had so long lain obscure, and Wotton in turn gave it to the world with the emphasis it deserved.

Had the discovery of the lesser circulation been heralded, one might think that it paved the way for the epoch making investigations which were to come, but we are justified in saying that until the time of Harvey, scientific investigation of the heart and blood vessels was a blank. Outside of the counting of the pulse in the arteries as early as 1464 by one Cardinal Nicolaus Cusanus using a *Wasseruhr,* we have little or no record of observa-

* Read before the general meeting of the San Francisco County Medical Society, Jan. 14, 1913.

tions of value upon the cardio-vascular system in motion. Until the advent of Harvey the Galenical views that distole was the active part of the cardiac cycle, systole being merely a rebound, prevailed, and therefore it is more than remarkable genius that was shown in the discovery of the circulation. This achievement in 1628 is not only noteworthy in the facts elicited, but is of supreme interest from the point of view of the subject this paper is considering. Calling dissection the first step in the evolution of the study of the heart, Harvey was the first working in this field to use vivisection, and so gave us a new means of research in this domain.

We have noted how Harvey, with his path shrouded in the darkness of ignorance, lighted a beacon illuminating the way for all future investigations. His genius and the worth of his work have been given fulsome but well merited praise by the world and need no further comment. Still, to emphasize their value from the standpoint of our theme, we must again point out with stress that Harvey brought to cardiac science new means for investigation, first vivisection, and second injection methods, for it was by the latter that he demonstrated the capillaries.

Harvey having cleared up the matter of the circulation and having shown that the heart contracts in systole and relaxes in diastole, we look for the next definite progress in the study of the myriads of questions which would naturally arise. Before we come to that and mark it well, we are led into a bypath of tremendous interest, a line of thought which was the first result of Harvey's work. We refer to the famous and still continuing discussion on the neurogenic and myogenic theories of the heart beat. He might well be called the real formulator of the myogenic theory, i. e., that the heart beats because of certain properties inherent in the heart muscle itself, but in the same century Willis formulated the neurogenic theory. This latter investigator postulated that the organ beat because of impulse conveyed to it from the cerebellum via the vagus. Haller's publications in 1757 were important in that they enunciated the myogenic theory as it is largely held to-day, i. e., that inherent irritability of the cardiac musculature is responsible for the heart's contraction and this irritability is replenished by the constant inflow of venous blood. Legallois in 1812 formulated the second neurogenic theory, to the effect that the cardiac impulse originated in the spinal cord and entered the heart via the sympathetic nerve. Bichat in the middle of the last century held that a ganglionic system governed all the viscera, and Remak's discovery in 1844 of inherent ganglion cells in the heart, lent great strength to this theory. Bichat's views held forty years until Gaskell in 1881-1883 published his convincing and remarkable experiments on the hearts of the frog and tortoise, which showed certain inherent functions of the heart muscle and proved that the ganglia represented merely an inhibitory apparatus.

Temporarily, we must leave these theories as far as we have brought them. They hardly mark, until the time of Gaskell, the epochs we are attempting to trace, and the arguments they brought forth were characterized for the most part by philosophizing rather than by advances in the methods of the study of the problem, and it is after all, with that, that we are at present most concerned.

To return to 1628, the date of Harvey's discovery, we search from there on for further disclosures in either facts or methods. We find nothing of tremendous importance until we come to Auenbrugger nearly a century later. True, Stephan Hales had introduced a sphygmascope in 1683, but that represented a small matter in comparison with Auenbrugger bringing percussion into use in 1722. This was perfected by Corvisart in 1809, the Napoleonic physician, and since then we know many names in this connection, notably, Skoda, Wintrich, Friedrich and Gerhardt.

This brings us to Laennec and the year 1819, and the part he played in the study of the heart is indirectly almost as great as that of Harvey, but alas not so beneficial. His introduction of the stethoscope and the all important emphasis medicine has since placed upon it, have marked one of the most if not the most splendid mistake in medicine. The mystery of sound, and at the same time its fascination, turned the attention of the best thought of that and later periods to the sounds of the heart and their modifications as the be-all and end-all in the study of the heart and its diseases. A great school of admirable and artistic cardiac clinicians grew and thrived under this conception, the school of murmurs they might be aptly termed. By the aid of auscultation, much of the hitherto obscure physical dynamics of the organ came to light, the causation of the heart sounds themselves became clear, and murmurs assumed a lucid significance.

The unfortunate feature of these things, however, was that, though they did open up new avenues for the diagnosis of the diseased heart, these avenues were actually blind alleys; and though they did give us a view, they brought us into little closer contact. In fact the real trouble was that they gave us a view but no real acquaintance; they introduced us to the morbid anatomy and we became enabled to say that such and such a valve was insufficient or stenosed, but came hardly into more intimate acquaintance with the pathological physiology of the organ, which knowledge is so essential to the correct understanding and intelligent management of its diseases. Spurred on by these ideas flourished so many noted men—Broadbent, Gibson, Friedrich, Austin Flint, names selected at random but typifying the class of heart clinician now passing. These men left us with little greater efficiency than we had before their time and it remained for our own century still so young, finally to put the study of heart disease on a basis actually fruitful and giving golden promise for the future.

Properly to understand this indispensable work of the last quarter century, which has done more than all the work of the aeons before, to give us real knowledge, it is imperative to glance at the development of the recent anatomical and physiological researches of striking importance. Stannius, Gaskell and Englemann in the '80's showed that the beat of the mammalian heart originates in the sinus venosus. Stanley Kent of Oxford in 1892 gave the first description, however imperfect, of the muscular connection between auricle and ventricle. His Jr. of Berlin in the next year gave a more perfect account of the same structure which has since born his name, but Tawara, working under Aschoff in 1908 gave the most complete description we have and at the same time described the auricular-ventricular node which we know under his name and which shortly was to play such an interesting role in the explanation of certain cardiac rhythms. The year previous to this, Keith of the Royal College of Surgeons, London, working in collaboration with Flack, recognized at the junction of the superior vena cava and right auricle another node, the sino-auricular representing remnants of the primitive cardiac tube. This node was also destined to a part of importance, for it was here in the last two years that it was found that the normal rhythm of the heart receives its impulse, and this region was named by Lewis the pace-maker of the heart. As early as 1856 Kölliker and Müller had demonstrated a current of electricity in the organ by placing a nerve muscle preparation in contact with the beating heart, and Waller in 1889 studied these electrical conditions and recorded them accurately by means of photographing the movements of the mercury meniscus of a capillary electrometer. The climax of these studies found its expression in 1903 when Einthoven of Leyden brought the string galvanometer into practical use for these purposes and gave us the electrocardiograph. This instrument and method of investigation has proved not only efficient but indispensable in clearing up many obscurities, and without its aid the discovery of auricular fibrillation, the greatest recent single advance of all, would not have been accomplished.

This, however, brings us a little ahead of our story and before going further we must turn our attention to the modern master who made this progress possible. The comparatively small English manufacturing town of Burnley in the last decade of the last century contained as its leading practitioner James Mackenzie, a thorough going Scot passed middle life and of so endearing a personality that the inhabitants not only looked to him for their medical welfare but their moral and social as well. He himself has said that he knew his patients and their families so well, most of them of the working class, that he entered their houses as often through the back door and kitchen as by the front entrance. His practice, as he records it, numbered as many as 3,000 patients; in fact he was so adored in the town that every one there refused to die without first seeing Mackenzie. The character of the practice was general, in fact there are some enlightening neurological observations of his on record, made upon surgical cases. Picture a man so occupied with medical routine finding the time and having the mental capacity for epoch-making observations and publications in the midst of it all, and the marvel of it becomes overwhelming.

In 1893-4 he published his first papers on the venous pulse, and these papers with the many that followed gave the impetus to the graphic method of the study of heart disease, which led to a field of knowledge of limitless extent, hitherto unexploited. True, Lancisi and Morgagni in the eighteenth century had made slight reference to the venous pulse and in 1794 Hunter had described it in the veins of the dog, but clinical thinkers had ascribed little moment to it, and it remained for the master mind of Mackenzie to realize what an important weapon the study and recording simultaneously of the venous and arterial pulses is in the clinical aspect of the heart. It was not the mere study of the pulses or the elaboration of a graphic method that actuated Mackenzie. The greatness of it lies in the newer and finer attitude he brought by these means to the study of the heart. Murmurs and heart sounds, though fascinating, helped us little in estimating cardiac possibilities for work under either normal or diseased conditions. Mackenzie gave us the conception of considering the organ from the standpoint of how much work it can do. To calculate this one must have actual knowledge of what the heart is doing and what it does under changed conditions. He found this knowledge could be attained through the graphic method, and so thrusting aside murmurs and valves for the time being, he turned his attention to the myocardium, and found that there lay the crux of the whole situation. In brief, it may be said that Mackenzie was the first to conceive that all dealings with the heart must be thought of and expressed in terms of the myocardium and its power for work, or to put it more clearly, he found that the pathological physiology of the heart contained the problems to be studied.

Working along those lines, he and those inspired by him attacked the arrythmias. Until then an irregular heart was called an irregular heart and nothing further, but Mackenzie discovered that the arrythmias are varied and protean in type. These different types had hitherto been effectually concealed, like a gopher in a hole, but Mackenzie smudged them out, and now we know the sinus or juvenile type, the paroxysmal tachycardia, auricular and ventricular, the extra-systole, the heart block, the bradycardias, the pulsus alternans, and other types. We are able to differentiate the serious ones from those of little import, and this only by the graphic method.

We now approach the extremely important discovery of auricular fibrillation, an outgrowth of Mackenzie's work. The pulse accompanying so-called decompensated cases of mitral disease, the "mitral pulse" had long been known and was early described by Marey, Riegel, Sommerbrodt and others. In later years Hering gave it the title "pulsus irregularis perpetuus," a most satisfactory and self-explanatory title. Mackenzie in taking records of these cases noted that the venous pulse showed a systolic movement and termed this the ventricular form of venous pulse. The presystolic or auricular movement being absent, he argued on negative evidence, that the auricle was paralyzed and the ventricle was assuming an irregular and independent rhythm. Later on he discovered evidence that the auricle was in some sort of motion and so then he formulated his theory of "nodal rhythm." This held that if the auricle is beating but there is no separate auricular wave in the venous pulse, it must then be beating at the same time with the ventricle, and to do that it must be responding to impulses originating in the auricular-ventricular node. This idea prevailed for some years until Thomas Lewis, a pupil of Mackenzie of almost superhuman experimental ingenuity working in the University College, London, addressed himself to the subject.

In the course of experiments along other cardiac lines he noted, as others had, that electric stimulation of the auricles at a certain stage in the amount of stimulation used, caused them to enter a state of fibrillation and that during this fibrillation, the ventricles assumed a rhythm and gave a peripheral pulse record exactly similar to the "pulsus irregularis perpetuus" in man. The electrocardiograph being now at hand, it occurred to him to sew electrodes into the auricle, sew up the chest and take electrocardiograms of the animal in which auricular fibrillation could be produced at will. These electrocardiograms he compared with those of patients having the "mitral pulse" or "pulsus irregularis perpetuus," and found them identical. Mackenzie's idea of nodal rhythm had to give way to the proven fact of auricular fibrillation, and Mackenzie himself was the first to recognize and accept it.

The significance of this discovery was tremendous. Hirschfelder in Baltimore a little over a year previously had mentioned auricular fibrillation in connection with paroxysmal tachycardia but his ideas later were shown to be erroneous and he had not at all the conception of the true relationship of auricular fibrillation to clinical cases. Rothberger and Winterberg of Vienna one year before (1909) had hit upon the phenomenon independently, but they had not given it as elaborate experimentation and detailed complete proof, and the achievement will go down in medical history as Lewis's work.

This threw a new light on our previously termed "decompensated" hearts and for the first time in medical history we knew just what was happening in such cases. Naturally the first question presenting itself would be, how does that help us if at all? Is there any more we can do for these patients now than we could before, just because we know what their auricles were fibrillating? This very question occupied Mackenzie and particularly one co-worker, Cushny. They turned their attention to the therapeutics of this affection and soon found that an old drug, differently used than hitherto, namely digitalis, became an all powerful weapon. I say differently used, meaning used from the standpoint of the myocardium. Cushny, bearing the properties of the myocardium in mind discovered that digitalis had a selective action upon conductivity, delaying that function and thus slowing the ventricle by blocking many of the myriads of impulses arising in the fibrillating auricle. Infinitely better results than heretofore were obtained, by checking the use of the drug by the graphic method in each individual case. This and related phenomena led Cushny and Mackenzie to study the drug anew and resulted in an infinitely clearer understanding and fuller knowledge of the use of what is probably the main therapeutic agent we have in heart disease. Their publications are extremely recent, the last but a little over a month back, but the detail of cardiac therapy lies without the scope of this paper and will be considered elsewhere at a later date.

It must not be inferred that it is the writer's idea that Mackenzie was the first to use the recording of the pulse in the study of the heart. Ludwig, in 1847, working in the physiological field composed the kymograph for the laboratory. Hering and Hurthle later improved on it and brought it to its present effective state as a physiological instrument. Ludwig studied the velocity of the blood by means of the *stromuhr* in 1867 but it was really Vierordt in 1855 who first applied the graphic method to the study of the pulse. Marey in 1860 devised the sphygmograph and a few years later Dudgeon gave us the improved and now familiar instrument. The physiological laboratories had for years recorded the pulse and heart motions by means of manometers, tambours and cannulae, but it remained for Mackenzie to correlate these methods and give them a working application in the clinical study of the human heart.

Another important and earlier outgrowth of the graphic method is seen in the clarification of our knowledge of the condition we learned by these means to know as heartblock. Clinically, paroxysmal bradycardia was known as far back as 1761 when Morgagni described a case of "epilepsy with slow pulse." The first clear clinical description fell to the lot of Robert Adams of Dublin in 1827 who published one case. William Stokes, a fellow Irishman, published clear accounts of 4 cases 20 years after, and it is from the names of these physicians that the title Stokes-Adams disease or syndrome is derived. The fact that in this condition, auricle and ventricle were beating at different rates was first noted by Galabin of Guy's Hospital in 1875, who came to this observation through means of auscultation. Eight years later Tigerstedt and also Woolridge were successful in experimentally dissociating auricle and ventricle but their experiments did great damage to the whole heart and had little more than historic value. His in 1895, 2 years after his description of the bundle announced his experimental accomplishment of heart block but he published no tracings or specimens. Four years after this he described, as well as Wenkebach, human cases of heart block but Chauveau in 1885 had already done so in a rather primitive manner. Mackenzie in the years 1902-5 published the records of several cases and advanced our knowledge of the recognition of this condition vastly, but it remained for Erlanger in Johns Hopkins University, in a series of experiments as ingenious as those of Lewis on auricular fibrillation, to disclose to the world all the obscurities which had hitherto been connected with the subject. It is now well known how by means of a specially devised clamp, he was able, by compressing the His bundle to any degree wished, to produce all degrees of heart block, from the mere dropping of a ventricular systole, to complete block. He did not confine his studies to experimental work alone, but by studying human cases at the same time, he found it possible to draw convincing analogies and conclusions which later autopsies from all parts of the world amply verified. These cases were naturally studied by the graphic method, in fact the information would have been obtainable by no other method. It remained for the electrocardiograph, whose records are accuracy beyond question, to confirm the whole matter.

The discovery of heart block and the interdependence of the contraction of auricle and ventricle, upon muscular connection seemed at once to be the last word in the proof of the hyogenic theory of the heart, which discussion we had left at the time of Gaskell's work. Further light, probably in support and confirmation of this theory will be found in some startling experiments now going on in this country. We refer to the work of Carrel in the Rockefeller Institute and his "visceral organism" which opens possibilities for the observation of the heart beating apart from the influences of the central nervous system.

The appurtenances of the graphic method did not stop with the sphygmograph, the polygraph and the electrocardiograph. As is often the case, the method has been driven to extremes, and innumerable refinements, modifications, and new instruments sprang up on every side, some of them ingenious but most of them leading into unproductive by-paths. Many workers along these lines became befogged and mistook the means for the end. A large group of physicians seized eagerly upon the new toys and spent much labor collecting tracings, but little labor upon their interpretation. For such, the more complicated polygraphs which were furnished had an irresistible fascination, for in sooth these instruments would give simultaneous tracings of the venous pulse, arterial pulse, apex beat and blood pressure, and ingenuity is developing to such a degree that it would not have been surprising had some machine been invented to do all these things and in addition supply music for the patient's entertainment and tell his fortune. Nevertheless there were some inventions of interest and mayhap of promise, notably Moritz's Orthodiagraph and Frank's apparatus by means of which heart sounds could be graphically recorded.

Pausing now at the distance to which we have trudged in all these years and looking back at the beginnings, we must realize the tremendous revolution the last 20 years have wrought for us. Harvey took us by the hand and led us out of superstition. Laennec was the siren who lured us from the straight and narrow path and tempted us into the land of fascination but little accomplishment; but Mackenzie was the deliverer who led us from out of the wilderness into the light. It was he who taught us that such diagnoses as mitral incompetency or aortic stenosis said a little, not much and certainly not all in the case of a heart suffering from chronic disease. It was he who conceived the idea that for us to be effective in the handling of diseased hearts, we must know what they are doing and can do, and he pointed out the means by which such knowledge is readily obtainable. Looking at heart disease from this point of view we can, as he emphasized in his Oliver Sharpey lectures of last year, get a rational basis on which to diagnose, prognose, and treat. His work, and all that followed under his inspiration, directly or indirectly, promises bright things for the future of our fight against heart failure, and even though we should not find the actual cures we hope for, we now at least have the satisfaction that we are approaching the problems rationally, and that after all is the most advanced aim for which we could wish.

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(The bibliography here submitted is not meant in any sense to be complete, but represents merely the main sources from which the material for this article, i. e., the historical material was obtained. Several of the references here given in themselves give complete bibliographies, notably the volume by Mackenzie and that by Lewis.)

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STEREO-ROENTGENOGRAPHY IN PULMONARY TUBERCULOSIS.*

A CLINICAL AND ANATOMICAL STUDY.

By WALTER W. BOARDMAN, M. D., San Francisco.

The question of the value of radiographic examination in the diagnosis of pulmonary tuberculosis is one which has called forth widely varying opinions. To investigate this question a complete stereo-roentgenographic apparatus was installed in the Phipps Dispensary of the Johns Hopkins Hospital and arrangements made for the study of a large series of cases, the radiographic findings being checked by careful clinical and when possible by autopsy examination, the work being carried on by Drs. Dunham, Wolman and myself.

As you may recall the X-ray is a form of radiant energy possessing the following important properties. The rays radiate in straight lines from their point of origin, they can neither be reflected nor refracted, they are capable of penetrating bodies opaque to ordinary light, in penetrating various materials the degree of absorption of the rays is directly proportional to the specific gravity of the materials, and finally the rays are capable of exciting photographic plates. We have, therefore, in the X-ray a means of recording differences of density occurring normally or abnormally in the tissues of the human body.

In a radiograph of the chest we have then a shadow picture in which the dense tissues or struc-

* Read before the California Academy of Medicine, May 27, 1912.